CLAIMS

(57) [Claim(s)]

[Claim 1] with the laser which operates in the mode which is a system for recording a data pattern on the flat-surface substrate which obtains and has cone coating, and was pulse-ized The means for loading the mirror array optical modulator which can be transformed and the aforementioned data pattern which are irradiated by the aforementioned laser to the aforementioned modulator, The reducing glass which forms the picture to which the aforementioned modulator was reduced on the aforementioned substrate is included. The aforementioned reducing glass is positioned to the aforementioned modulator in the mode which enables only light reflected by the mirror which was activated with the aforementioned data pattern, and in which the aforementioned deformation is possible to reach the aforementioned reducing glass. The light which carries out incidence to the aforementioned flat-surface substrate, without the light which carries out incidence to the aforementioned modulator damaging the aforementioned modulator so that it may have sufficient power concentration to picturize coating on it and enough The means for reducing the image of the aforementioned modulator on the aforementioned substrate, and generating relative motion between the aforementioned substrate and the aforementioned reducing glass, It by combining two or more pictures by which reduction was carried out [aforementioned] including the means for synchronizing with the aforementioned relative motion the optical pulse of the aforementioned data pattern in the aforementioned modulator, and the laser pulse-ized [above] the system which obtains the aforementioned laser beam which the aforementioned bigger substrate than the picture by which reduction was carried out [aforementioned] is for recording the aforementioned data pattern above a part, and reaches the aforementioned flat-surface substrate on the aforementioned flat-surface substrate, and can carry out ablation of the cone coating

[Claim 2] The system for recording a data pattern on a flat-surface substrate according to claim 1 whose laser pulse-ized [above] is excimer waveguide laser.

[Claim 3] The system for recording a data pattern on a flat-surface substrate according to claim 1 which is the reticle used in order that the aforementioned flat-surface substrate may manufacture a semiconductor.

[Claim 4] The system for recording a data pattern on a flat-surface substrate according to claim 1 which is the silicon wafer with which the aforementioned flat-

surface substrate was used in manufacture of a semiconductor.
[Claim 5] It is a system for the aforementioned record being performed by the ablation of the thin layer of the ultraviolet-absorption color deposited on the substrate, and the further processing of the account substrate of back to front of record recording a data pattern on the flat-surface substrate according to claim 1 which is not needed at all.
[Claim 6] The system for recording a data pattern on a flat-surface substrate according to claim 1 proved by measuring the amount of the light by which the data with which the aforementioned record was performed by the ablation of the thin layer of the ultraviolet-absorption color deposited on the aforementioned substrate, and record was carried out [aforementioned] were immediately passed through the substrate after record of the aforementioned data.
[Claim 7] The system for recording a data pattern on a flat-surface substrate according to claim 1 by which the aforementioned record is performed the ablation of the thin layer of the ultraviolet-absorption color deposited on the aforementioned substrate, and the aforementioned ablation is performed in the atmosphere of gases other than air.
[Claim 8] The aforementioned substrate is covered with the material of at least two thin layers, and it is used in order that one side of the aforementioned layers may shift the phase of the light penetrated through a substrate. On the other hand, the system for recording a data pattern on a flat-surface substrate according to claim 1 by which the opaque mask by which another layer can be recorded with the aforementioned laser is formed, and the combination of a substrate and the aforementioned layer forms a phase shift mask.
[Claim 9] The aforementioned substrate is covered with the material of at least two thin layers, and it is used in order that one side of the aforementioned layer may shift the phase of the light penetrated through a substrate. On the other hand, the opaque mask by which ablation of another layer can be carried out with the aforementioned laser is formed. And the system for recording a data pattern on a flat-surface substrate according to claim 1 which forms the phase shift mask which may be proved by measuring the amount of the light by which the combination of the aforementioned layer is penetrated through a substrate after record of the aforementioned data.
[Claim 10] the system for recording a data pattern on the flat-surface substrate which obtains and has cone coating characterized by providing the following Laser which operates in the pulse-ized mode. The means for loading the mirror array optical modulator which can be transformed and the aforementioned data pattern which are irradiated by the aforementioned laser to the aforementioned modulator. The reducing glass which forms the picture to which the aforementioned modulator was reduced on the aforementioned substrate is included. The aforementioned reducing glass is positioned to the aforementioned modulator in the mode which enables only light reflected by the mirror which was activated with the aforementioned data pattern, and in which the aforementioned deformation is possible to reach the aforementioned reducing glass. The light which carries out incidence to the aforementioned flat-surface substrate, without the light which carries out incidence to the aforementioned modulator damaging the

aforementioned modulator so that it may have sufficient power concentration to picturize coating on it and enough The means for reducing the image of the aforementioned modulator on the aforementioned substrate, and generating relative motion between the aforementioned substrate and the aforementioned reducing glass. A means to load a data pattern to the aforementioned modulator, and to shift it to each spot on the aforementioned substrate synchronizing with the pulse and relative motion from the aforementioned laser in order to expose the data corresponding to the spot many times.

[Claim 11] The system for recording a data pattern on a flat-surface substrate according to claim 10 whose laser pulse-ized [above] is excimer waveguide laser.

[Claim 12] The system for recording a data pattern on a flat-surface substrate according to claim 10 which is the reticle used in order that the aforementioned flat-surface substrate may manufacture a semiconductor.

[Claim 13] The system for recording a data pattern on a flat-surface substrate according to claim 10 which is the silicon wafer with which the aforementioned flat-surface substrate was used in manufacture of a semiconductor.

[Claim 14] It is a system for the aforementioned record being performed by the ablation of the thin layer of the ultraviolet-absorption color deposited on the substrate, and the further processing of the account substrate of back to front of record recording a data pattern on the flat-surface substrate according to claim 10 which is not needed at all.

[Claim 15] The system for recording a data pattern on a flat-surface substrate according to claim 10 proved by measuring the amount of the light by which the data with which the aforementioned record was performed by the ablation of the thin layer of the ultraviolet-absorption color deposited on the aforementioned substrate, and record was carried out [aforementioned] were immediately passed through the substrate after record of the aforementioned data.

[Claim 16] The system for recording a data pattern on a flat-surface substrate according to claim 10 by which the aforementioned record is performed the ablation of the thin layer of the ultraviolet-absorption color deposited on the aforementioned substrate, and the aforementioned ablation is performed in the atmosphere of gases other than air.

[Claim 17] The aforementioned substrate is covered with the material of at least two thin layers, and it is used in order that one side of the aforementioned layers may shift the phase of the light penetrated through a substrate. On the other hand, the system for recording a data pattern on a flat-surface substrate according to claim 10 by which the opaque mask by which another layer can be recorded with the aforementioned laser is formed, and the combination of a substrate and the aforementioned layer forms a phase shift mask.

[Claim 18] The aforementioned substrate is covered with the material of at least two thin layers, and it is used in order that one side of the aforementioned layer may shift the phase of the light penetrated through a substrate. On the other hand, the opaque mask by which ablation of another layer can be carried out with the aforementioned laser is formed. And the system for recording a data pattern on a flat-surface substrate according to claim 10 which forms the phase shift mask which may be proved by measuring the amount of the light by which the

combination of the aforementioned layer is penetrated through a substrate after record of the aforementioned data.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
Background of the Invention] This invention relates to generating of the mask and reticle which are more specifically used in semiconductor industry, concerning generating of a photograph means.
[0002] The advanced technology in semiconductor industry uses the method of being different in order to make the layer of the photoresist deposited on the crowning of a metal layer since a photograph means was generated expose. A photoresist is used as a mask for negatives being developed and ***********ing a metal layer after exposure (chromium typically deposited on crystal). Since it is accompanied by the development process, a pattern must have been inspected in the case of exposure. The 2nd disadvantage of a development process is a number of a defect of potential increases caused by using the process of two or more steps. The attempt of the advanced technology for generating a photograph means without photoengraving process includes the ablation of a metal or a polymer layer. These attempts are because the very short wavelength which was not successful, because was generated by only the excimer laser is completely needed for clean ablation. An excimer laser has low recurrence speed and it barred those use in high data speed application. A conventional light valve like liquid crystal does not fully pass the short wavelength of an excimer laser.
[0003]
[Summary of the Invention] According to this invention, the mirror space optical modulator which can be transformed is used with the guided type excimer laser of waves, and records many data bits by each laser pulse. The mirror optical modulator which can deform is equipment manufactured by Texas Instruments, Incorporated (Texas Instruments Inc.) (Texas leaguer), and the principle of operation is contained by U.S. Pat. No. 4,441,791. Detailed explanation of the operation is given in the paper of "the mirror space optical modulator (Deformable-Mirror Spatial Light Modulators) which can deform" (the 1150th volume of the minutes of 1989SPIE) by L.J. Horn Beck (Hornbeck). The further detailed nothing about this equipment is given here? The mirror array which can deform has an image drawn on the crystal substrate by which polymer covering was carried out with the typical reduction percentage of about 100 to 1. It originates in big reduction percentage, and the energy density on the mirror which can deform is

what 1000 times lower than the thing in a polymer, and ablation of the polymer may be carried out without the damage to a mirror in this way (ablate). in order to avoid the solid waste (mainly carbon) as a by-product of ablation — ablation — the atmosphere of inert gas (in order to prevent combustion) — or it is made in oxygen atmosphere (in order to make combustion of a solid waste complete) Since polymer covering of 2 level generates a phase shift mask, it may be used. The purpose of this invention is offering how twisting photoengraving process which is for generating the mask for semiconductor industry, and a photograph means like a reticle, and it is quick. The further purpose of this invention is proving, as soon as it is generated by comparing with transparency of a photograph means the data with which the photograph means' was written in it. Another purpose of this invention is generating and proving a phase shift mask. Still more nearly another purpose of this invention is having equipment suitable for the both sides of what a true image's is drawn for on photograph means generating and a photoresist (namely, direct writing of a up to [a silicon wafer]).

[0004] It will become clear by the explanation of the followings of these to which other purposes are performed in relation to a drawing by reaching to this invention.

[0005]

[Explanation of invention] If drawing 1 is referred to, the beam by which light 2 which the space optical modulator 1 of the mirror in which two-dimensional deformation is possible is generated by the excimer laser 3, and is turned to up to a modulator 1 by the mirror 4 was pulse-ized will irradiate. When the mirror in 1 which can be deformed is not activated, a light beam 2 is reflected in an absorber (absorber) 6 as a light beam 5. The activated mirror forms the beam 7 turned to the lens 8. A lens 8 is formed on the substrate 9 with which the picture 10 of the mirror by which activity was carried out was covered. On the other hand, it is moved to a direction by the precision stage 11, and a substrate 9 is moved in the other directions by the precision stage 12. The information which the position of the stage 11 was measured by the interferometer 13, and was given by the interferometer 13 is used in order to synchronize the both sides of the data loaded the optical pulse from an excimer laser 3, and into a modulator 1. It is because to show the detail of the precision stages 11 and 12 and an interferometer 13 here is not needed, because this type of X-Y stage is common practice in semiconductor industry. The only difference between the practice on industry and this invention in the field of the precision stage is the fact of being used only since an interferometer 13 is not used in order to control the position of the stage 11, but it measures it and generates timing information based on a temporary position of the stage 11. This is more easy and more more exact than it is going to control the position of the stage 11.

[0006] A photograph means may be generated from a substrate 9 in two different methods. The 1st thing is the conventional method of using crystal / chromium / photoresist structure, and making expose a photoresist, and ***********ing chromium as a mask using it. The same method is used, when using this invention, in order to write in on the silicon wafer by which photoresist covering was carried out. The 2nd method consists of covering a crystal substrate with a thin polymer

layer using a polyimide with a thickness of about 1 micron. This layer forms a photograph means, without carrying out ablation by the excimer laser, and needing any further processings. In order to bar formation of a solid waste as a by-product of ablation, process gas 15 is supplied by the nozzle 14 through an ablation field. process gas — inert gas — or it may be oxidization gas An excimer laser 3 is XeCl waveguide laser which operates by 308nm as an example. The laser is Potomac Photograph NIKUSU, Incorporated (Potomac Photonics Inc.) (it is made by Lanham (Lanham) (MD) and generates to a 100micro joule for every pulse at the recurrence speed of 1,000Hz.). By using the reducing glass of the mirror modulators 1 and 85X which have the element of 1,000x1,000 on a 17-micron pitch (these numbers are typical to the modulator made by Texas Instruments, Incorporated) and which can be transformed, each pixel in the exposed picture 10 is 0.2x0.2 microns. The size of a picture is 200x200 microns. The energy density of a picture 10 is equal to 0.1mJ(s) / 0.02x0.02cm2=0.255 J/cm2, and it is enough for ablation. The energy density on a modulator is a factor fewer than (85) 2=7225, and it does not fully do damage to a modulator by the low's. When used for other wavelength [like the stepper of g-line and i-line] whose photograph means is, the optical density of the polyimide in specific wavelength may be increased by addition of UV absorption color.

[0007] The further ablation is eliminated when the completed photograph means is used in an excimer laser stepper. The typical reduction percentage in a stepper is 5X, therefore it is because the energy density on a photograph means serves as a 25 time low factor of the energy density on a wafer.

[0008] The beam cross section of a waveguide excimer laser is not uniform, and since there is an inclination which serves as a gauss in at least 1 direction, it is needed in order to attain exposure with uniform beam profile correction of a certain form. Now, if drawing 2 is referred to, the overlap method will be shown and each point will be exposed 4 times here. By this, very uniform exposure can be performed using Gaussian distribution and the beam which carried out the trapezoid distribution so that clearly from the exposure state roughly shown in drawing 3 . The ablation of an excimer laser is a nonlinear process, and another advantage of two or more exposure arises from the fact that the 1st pulse of light is in the inclination to remove a material fewer than a subsequent pulse. In order to realize the exposure method shown in drawing 3 , data must be shifted in a modulator 1 towards countering the travelling direction of a substrate 9. A data shift synchronizes to the movement of a substrate 9 as follows. Now, in order to form the 200x200-micron field which is the example expressed numerically previously with reference to both drawing 1 and drawing 2 , when the pixel modulator of 1,000x1,000 which it reduced [1,000] by the ratio of 85X and had the image drawn uses it, a new exposure pulse must be generated every 100 microns of advance of a substrate 9. The sequence of exposure is shown in drawing 2 . An interferometer 13 generates a pulse every 100 microns. This pulse causes laser 3, emits the very short pulse (typically less than 100ns) of light, and makes the loading process of the data to a browning tone machine start. Since laser 3 operates by about 1,000 pulses per second, the data speed to a modulator is abbreviation 1G bit per second. An effective writing speed is 250M bit per second,

and that is because each bit is exposed 4 times. The effective writing speed which exceeds 1G bit per second for a bigger modulator than laser's and a quicker recurrence speed is possible. the speed of the advance to a substrate 9 — 100 microns per ms — or it is 100mm/second Conclusion (typically 200mm or 2 seconds) of each scan and 100 microns of positioners 12 move in the rectangular direction. After each exposure pulse, data are shifted in a modulator, as shown in drawing 2 . The characters A, B, and C in drawing 2 etc. show with a sign the data pattern loaded into the modulator.

[0009] The structure of a photograph means is shown in drawing 4 . The crystal substrate 9 which has the thickness of 3mm or 6mm typically is covered with about 1-micron polyimide 16. A polyimide may increase the optical density on specific wavelength like g-line or i-line including an organic dye. The overcoat 19 which consists of a polymer which has the threshold of higher ablation may be given in order to make a damage threshold increase, when used in an excimer laser stepper. The thickness of an overcoat 19 is 0.1 microns or 0.2 microns at a 1-micron fraction and a type target. An ablation process is self-limitation-like when a crystal substrate is exposed.

[0010] Since resolution is increased when used in a stepper, the mold of the mask known as "a Levenson type phase shift mask (Levenson type phase shift-mask)" may also be manufactured using this invention. In this mask, the mutual clear feature has the 180-degree optical phase shift given to them. The phase shift mask which fits i-line stepper and is in agreement with invention of a parenthesis as an example is shown in drawing 5 . The crystal substrate 9 is covered with the layer of the positive form photoresist 20. The thickness of a layer 20 will be calculated if a 180-degree phase shift is exactly given on i-line wavelength. On the crowning of a layer 20, the layer of about 1-micron polyimide 16 deposits. While a pattern is that the mutual feature is cut by even crystal by using the ablation ratio from which the positive form photoresist of a polyimide differs, and using two or more exposure, other features may be cut in a method which is cut only in a top layer. The completed mask is shown by the cross section in drawing 5 . The whole mask is exposed by strong i-line irradiation from a mercury arc lamp after completion. This causes that a positive form resist comes to have a translucency to i-line. As an example, the floodlighting exposure for [to an arc lamp] 5 minutes will cause that a phase shift layer comes to have 99% of translucency on i-line wavelength. The opaque layer 16 is not influenced by i-line.

[0011] The possible additional feature is the actual proof of the photograph means generated in this invention. This process is roughly shown in drawing 4 . A lens 17 draws the portion by which the field where the present image was drawn on the charge-coupled-devices (CCD) array 18 was completed. Using the example of drawing 2 , the completed portion is a portion which receives the 4th exposure. This portion forms the quadrant of the exposed field. In order to draw the completed 250x250-pixel portion of the present exposure by the picture, by using a 250x250 element CCD array, it is obtained for the actual proof of data and detection of a defect of high resolution. This operation is widely used in optical data storage, and is known as "after [writing] read-out." The further detail [data] of handling is not given. The analog output of CCD is measured with the

presetting criteria 22 by the comparator 21, and is changed to binary data. This data is compared with the data loaded to the modulator, and generates a defect map for a write-in pattern.

[0012] By setting it as the level showing the threshold of the photoresist (for example, photoresist used on a silicon wafer when this photograph means is exposed in a stepper) which should be used with this photograph means in a threshold 22, the performance of a mask may be evaluated quickly. Especially this is important to a phase shift mask, and that is because it is what those performances cannot expect easily. If it has the lens and the analogous performance which the lens 17 in drawing 4 is used in a stepper, the data outputted from a comparator 21 will give the display which can trust the performance of this mask in a stepper. In order to make the minimum an error caused by quantization for the actual proof of a mask performance, the resolution of CCD18 must be higher than a modulator. For example, CCD of the element of 1,000x1,000 may be used in the example of the point of the image formation which is 250x250 bits.

[0013] These and other purposes of this invention will become clear in the following explanation in relation to the attached drawing.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram of a desirable example.
[Drawing 2] It is drawing showing how to overlap the write-in picture used in order to make the homogeneity of exposure increase.
[Drawing 3] It is drawing of a graph showing the homogeneous increase in the exposure attained by the exposure method which overlapped.
[Drawing 4] It is the cross section of the photograph means which also shows an inspection principle.
[Drawing 5] It is drawing showing the cross section of the photograph means when making a phase shift mask.
[Description of Notations]
1 Mirror Space Optical Modulator
4 Mirror
5 Light Beam
8 Lens
9 Substrate
10 Picture
13 Interferometer
14 Nozzle

[Translation done.]

* NOTICES *

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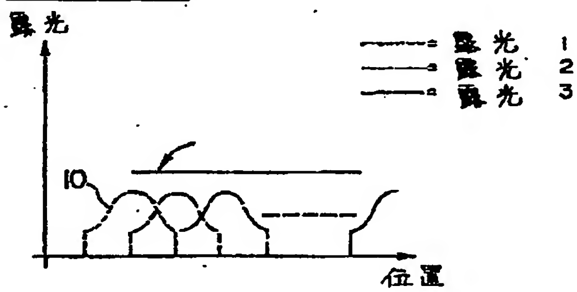
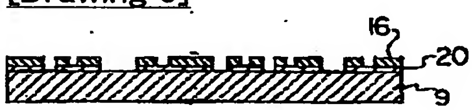
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

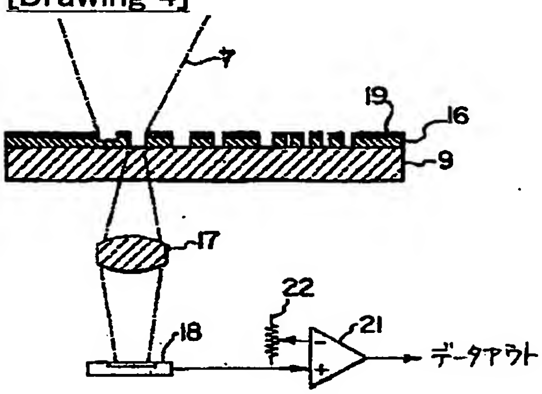
[Drawing 3]



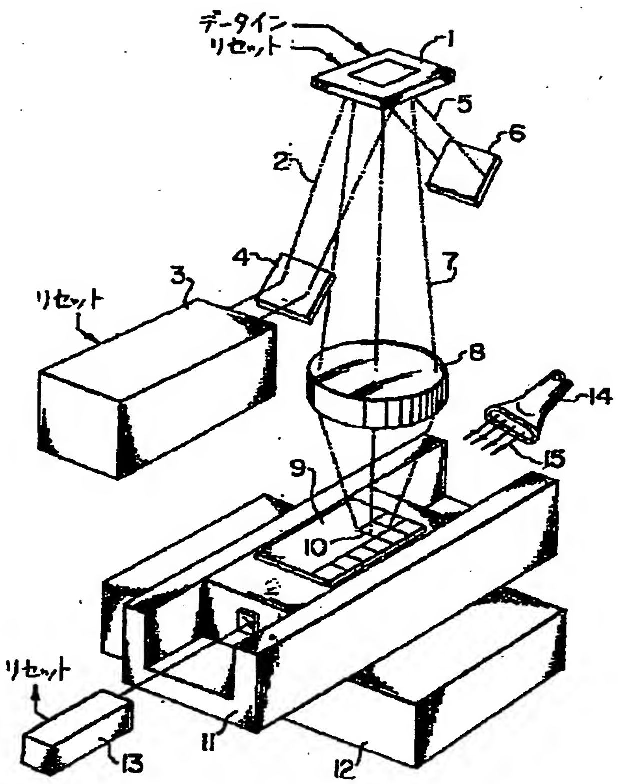
[Drawing 5]



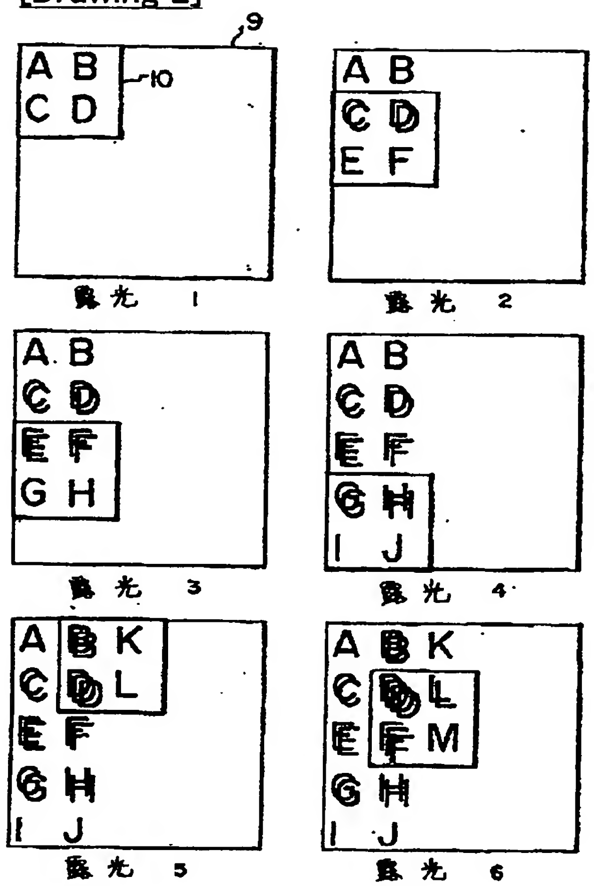
[Drawing 4]



[Drawing 1]


データイン
リセット
1
5
6
2
4
3
7
リセット
8
14
15
9
10
リセット
13
11
12

[Drawing 2]


9
A B
C D
10
露光 1
A B
C D
E F
露光 2
A B
C D
E F
G H
露光 3
A B
C D
E F
G H
I J
露光 4
A B K
C D L
E F
G H
I J
露光 5
A B K
C D L
E F M
G H
I J
露光 6

[Translation done.]